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Information Item

Educational Policy and Programs Committee

Graduate Education and Research in California Postsecondary

Higher education is recognized as the foundation on which to build the research, innovation, technology transfer and entrepreneurship needed to vitalize the state's economy. It is the base upon which the attitudes and skills of the workforce are formed, and upon which the California's leadership cadre is developed.

Higher education has many essential, interrelated elements and it is often impossible to weigh the relative, independent importance of any one element. Nevertheless, it is clear that graduate study has a role central to higher education's social purpose.

Advanced, and especially doctoral, study is often seen as remote and distant from everyday concerns of the world. It is, in fact, at the core of all education: graduate schools train college faculty and, by extension, all teachers. Graduate study is necessary for research in virtually every field of knowledge. More than ever, it is apparent that success in research is essential to economic growth and development and to furthering our knowledge base.

The development of new knowledge through scientific research and the application of that knowledge through the development of technologies have been the cornerstones of economic growth in many states. Advancing a competitive advantage for California will depend, in part, on its abilities to support emerging, expanding, and transforming businesses with state-of-the art processes and products.

This item on graduate education and research provides an opportunity for California's independent colleges and universities, the California State University and the University of California to share with the Commission their respective vision for graduate education and research, their plans and needs, and their action agenda to address the issues they face.

Presenter: David E. Leveille.

Graduate Education and Research in California Postsecondary Education: Need and Future Direction

Background

For the past decade or more, California's focus in higher education and it's financial support has concentrated primarily on undergraduate education. Whether it is increasing access, ensuring that quality or affordability of the programs for students, the locus of attention has been at the undergraduate level.

More recently, the need for increased attention to the graduate level, including research, has been advanced as an area of growing concern not only within institutions of higher education but externally as well. Business and industry leaders in biotechnology, engineering, computer science, and other fields have expressed concern about the availability of graduate students and the linkages between research – be it pure or applied – and the needs of the State.

With such growing interest, the Commission has invited representatives of the University of California, California State University, and the independent sector of postsecondary education to present their perspective on graduate education, including program needs, financial support required, and plans to accommodate a larger graduate enrollment, if any.

Graduate education and research

The issue paper "Graduate Education and Research" in the August 1987 *Issue Papers for The Master Plan Renewed by the Commission For The Review of The Master Plan For Higher Education* provided the following accurate perspective on the role of graduate education and research in California's public and independent institutions of higher learning:

> "When we think of California's great public and private universities, we think of research and graduate education. Their greatness is defined by the fact and reputation of their graduate programs and research enterprise."

A great university is measured by the strength of its graduate programs, by the scholarly distinction of the faculty members who offer them, and by the quality of the students who pursue them. Since no university can achieve national or international preeminence in every field, selectivity is imperative in graduate education.

Between 1990 and 1999, graduate/professional enrollment has increased approximately 24 percent in California's sector of independent colleges

and universities. Some 75 independent colleges and universities belong to the Association of Independent California Colleges and Universities (AICCU). These institutions account annually for fully half of the Master, nearly half of the doctoral, and some two-thirds of the professional degrees.

Enrollments in graduate education programs in California's public universities have remained somewhat static for the last few years. As shown in Displays 1 and 2, the graduate enrollment of these institutions when compared with selected comparable institutions nationally illuminates the similarities and differences with comparison institutions.

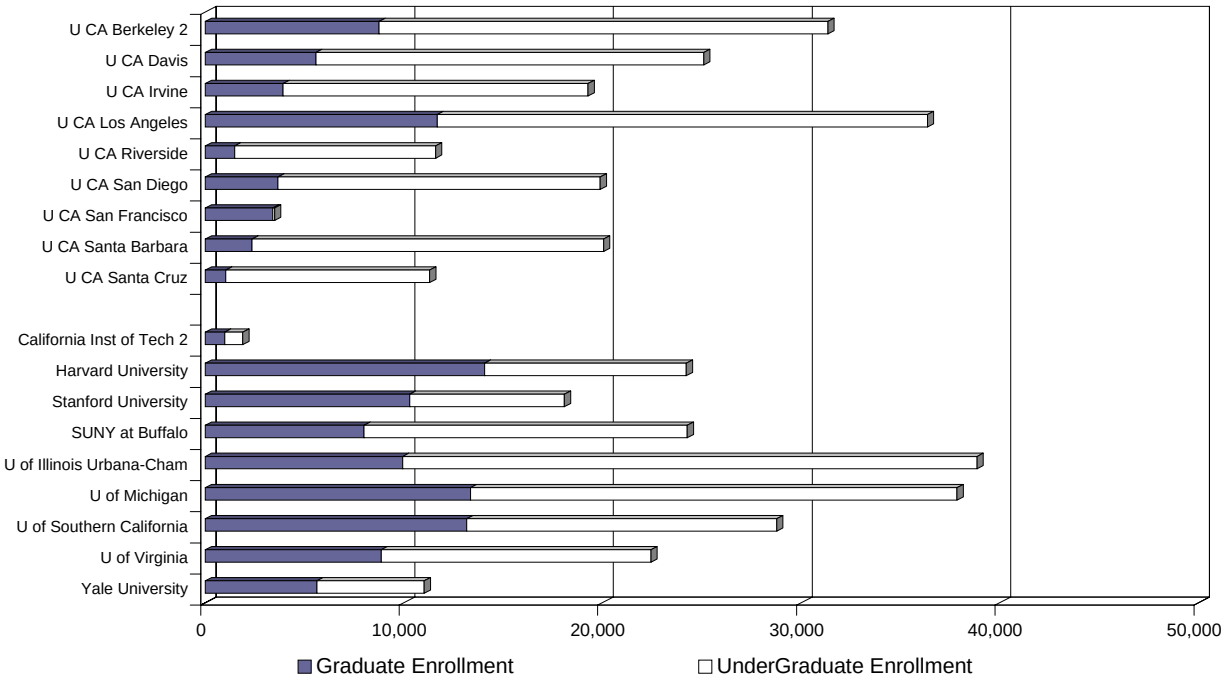
The Commission believes that a major effort in this decade should be devoted to strengthening graduate education. The exercise of program selectivity, the improvement of the quality of graduate programs, and the recruitment of well-qualified graduate students depend in large part on the academic leadership provided by department heads, deans, and institutional leaders. It depends, also, in the case of public institutions, on the collective will and vision of policy makers, their sustained commitment in terms of financial support, and the expectation that the public interest will be best served by distinguished programs or centers of excellence.

Graduate education not only passes on knowledge, examines it critically, and extends it in particular but also relates it to other knowledge and provides the student with conceptual tools to use the knowledge purposefully and consciously. The graduate professional function similarly relates a particular specialty to general knowledge and to society through conceptual and practical skills of the profession.

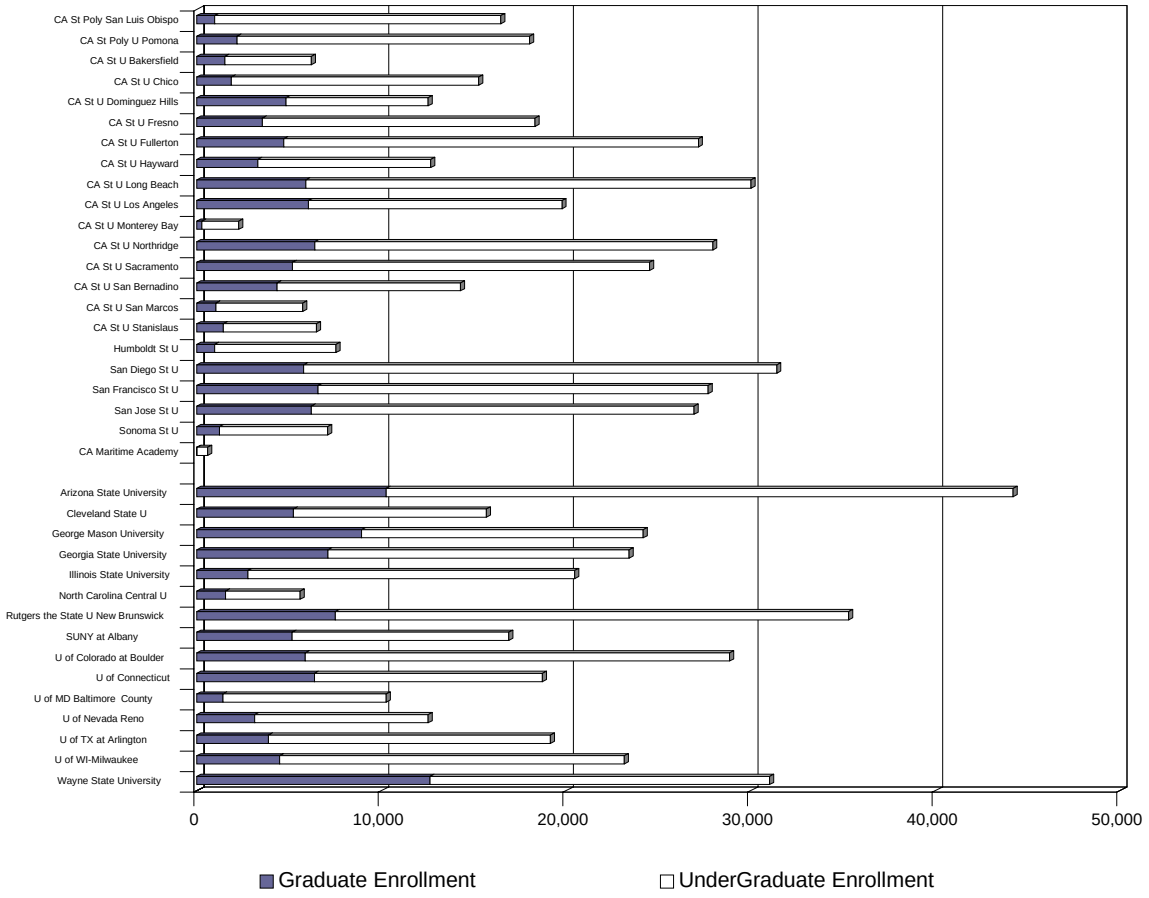
In California, as elsewhere, the control of graduate and graduate professional education in effect rests with departments and professional colleges. As a result the relevance of the concentration comprising the graduate or professional program is measured by the demand for the graduating talent produced. In graduate professional education the profession itself aids by interpreting society's needs and acting as an intermediary. The profession may be organized outside the university, or it may be organized within the university, as with academic professionals in departments.

In sum, the function of graduate and graduate professional education is threefold: (1) deciding which needs for leaders the university must meet; (2) giving high quality advanced training; and (3) equipping the graduate or professional student with conceptual tools by which he or she may relate to society through the field to cope with changing events and influence the future course of events.

DISPLAY 1 *Graduate and Undergraduate Enrollment in the University of California and Selected Postsecondary Institutions, Fall 1999*



DISPLAY 2 *Graduate and Undergraduate Enrollment in the California State University and Selected Postsecondary Institutions, Fall 1999*



In the middle of the 20th century when California was one of the few states supporting a world-class public research and teaching structure, attracting the finest graduate students was relatively uncomplicated. Now, however, every state in the country is a contender and the competition for graduate students is intense. Increasingly, it is necessary to offer a good financial package, a challenging research opportunity, and attractive fellowships in order to bring to California institutions those capable of break-through research and innovation.

The ability of California institutions, public and independent, to meet the competition emanating from a global economy and educational opportunity is limited. To be competitive and fulfill the State's interest as well as contribute to the economic vitality of the state and its citizenry, full attention needs to be given to strong graduate programs. Doctoral students are the research leaders of tomorrow. Outstanding graduate students invest their energies and knowledge in institutions boasting strong faculty, sophisticated research equipment and up-to-date library and information resources. Fresh graduate talent should be treated as a serious and ongoing priority. Assuring the necessary resources is essential to that commitment.

Research

Research, particularly university-based research, has both economic and educational values. By supporting creativity and the pursuit of new knowledge in all of its many forms, the State ensures that its postsecondary educational institutions' teaching and public service missions are vital and up-to-date.

Scholarship in its broadest sense includes (1) creative activity – development and transmission of original ideas and forms; (2) research activity – exploration, both basic and applied, to extend the boundaries of knowledge and technology using appropriate available methodology or devising new approaches, and dissemination of results; and (3) expository activity – new means of synthesis and presentation of existing knowledge.

The interaction of ongoing creative scholarship and research programs with instructional and public service programs gives California's institutions of higher learning, particularly the research universities, a distinctive character within the State. Through many scholarly activities these research universities contribute to the economic and cultural well being of California and to the solution of scientific, technical, and social problems confronting all of society.

The three functions often ascribed to higher education – teaching, research, and public service – are not separate but interdependent and complementary. Research is a basic component of good teaching, the source of new knowledge, and the means of producing scholars to carry out the work of expanding knowledge. The habits of mind necessary to function well as educated people are also those fundamental to research: curiosity, the ability to ask relevant questions and the competence to find ways to

progress toward answers. A good teacher develops these traits in students and exemplifies them in the approach to the field of study. Thus students and teachers are mutually involved in knowledge development. This process and interrelationship is especially characteristic of and fundamental to graduate education but can and should occur at all levels.

Public confidence in the ability of research to solve problems is high; yet there is ambivalence about the support of research in universities. The prioritization of limited resources toward undergraduate education has been and continues to be a significant commitment. One reason is the widespread, if ill-founded, impression that research competes with rather than contributes to the achievement of good teaching. Another source of reluctance to commit public funds is the inability to visualize the possible long-range benefits inherent in the basic research characteristic of much of the university-based activity.

Historically, the State of California has invested minimally in direct support for research activities at public universities. State expenditures for research in public universities in California did not increase in any significant degree until very recently. Most recently, the Governor's Initiatives relating to research did result in a marked increase. Funding support by the Governor has resulted in three (3) substantive research grants to the University of California in partnership with some of the most established private sector businesses in California. A commitment to a fourth project as soon as funds can be identified assures that more attention will be given to the role that research plays in the advancement of this State. It is important to note that the institutions are using the state appropriations that have been provided effectively as leverage to bring in many additional outside dollars for research.

Much research support comes from federal government. The cost of university-based research, however, is only a small proportion of expenditures for research in the United States. For example, in 1999, industries in this country provided 7.5 percent ($2 billion) of the total Research and Development (R&D) expenditures. In California, industry provided 6.6 percent ($236 million) in research dollars. California Research and Development clearly need a push from more university research.

On a national scale, the following display represents federal Research and Development flowing into California in comparison with selected states for the period of fiscal year 1999. The data in Display 3 suggests that California receives a significant revenue stream to its institutions of higher education, and leads the top 10 states nationally in total Research and Development monies received. Historically, California has led the nation in total Research and Development monies received as well as from federal sources since at least 1992.

DISPLAY 3 Research and Development Expenditures Nationally and for Selected States by Source of Funds, Fiscal Year 1999

R&D expenditures at doctorate-granting institutions, by state and source of funds: fiscal year 1999

[Dollars in thousands]

State	Total	Federal Government		State and Local Government		Industry		Institutional Funds		All Other Sources	
Total U. S.	27,038,008	15,782,855	58.4%	1,958,050	7.2%	2,016,039	7.5%	5,316,785	19.7%	1,964,279	7.3%
California	3,572,900	2,138,671	59.9%	166,656	4.7%	236,438	6.6%	723,232	20.2%	307,903	8.6%
New York	2,028,668	1,309,809	64.6%	82,155	4.0%	97,407	4.8%	318,344	15.7%	220,953	10.9%
Texas	1,800,582	954,841	53.0%	179,627	10.0%	159,439	8.9%	297,542	16.5%	209,133	11.6%
Pennsylvania	1,389,395	899,053	64.7%	51,785	3.7%	153,606	11.1%	200,269	14.4%	84,682	6.1%
Massachusetts	1,380,737	1,008,037	73.0%	32,735	2.4%	124,412	9.0%	85,095	6.2%	130,458	9.4%
Maryland	1,379,742	1,051,429	76.2%	76,096	5.5%	33,561	2.4%	150,686	10.9%	67,970	4.9%
Illinois	1,086,793	618,342	56.9%	60,265	5.5%	55,164	5.1%	270,777	24.9%	82,245	7.6%
North Carolina	980,612	515,116	52.5%	120,297	12.3%	178,754	18.2%	140,443	14.3%	26,002	2.7%
Michigan	913,823	505,545	55.3%	58,326	6.4%	59,130	6.5%	228,315	25.0%	62,507	6.8%
Georgia	828,886	371,177	44.8%	73,687	8.9%	89,612	10.8%	258,131	31.1%	36,279	4.4%

NOTE: Because of rounding, detail may not add to totals.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 1999

While is it often pointed out that universities tend to do research in the basic sciences whereas private industry research is based on the application of basic science, the reality is that these two concepts of research are by no means mutually exclusive. They complement each other, and university as well as industrial personnel carry on both. It is not surprising, therefore, to find the growth of high technology, knowledge-based industry occurring most frequently in close proximity to universities.

In fact, it is this cross-fertilization between academic and industrial research that distinguishes the United States from other nations and the reason that university scientific discoveries are rapidly translated into new industries, products, and service. The general economic health of California results in part from the resilience resulting from the high technology industries, which have developed here along with medical advances and biotechnology. Computer and electronic industries, agri-business,

biotechnology, and related fields, for example, are dependent upon university research capability and highly trained personnel.

A further indication of the relative strength of California institutions is reflected in Display 4. It is a comparison of total Research and Development expenditures at University of California and California State University campuses with several of their "comparable" institutions nationally from 1992 through 1999.

DISPLAY 4 Research and Development Expenditures

Total R&D expenditures at universities and colleges:
fiscal years 1992-1999
[Dollars in thousands]

Institution and ranking	1999	1998	1997	1996	1995	1994	1993	1992
California State University								
CA Maritime Academy								
CA St Poly U Pomona	1,069	1,331 i	1,589 i	1,847 i	2,105 i	2,363 i	2,621	1,784
CA St Poly San Luis Obispo	11,892	5,972	5,648 i	5,324 i	5,000 i	4,676 i	4,352	3,079
CA St U, Bakersfield	200 e	274 i	346 i	418 i	490 i	562 i	634	--
CA St U Channel Islands								
CA St U Chico	3,106	3,376	3,558	1,629	3,413	2,158	2,158	1,826 i
CA St U Dominguez Hills	8,517	7,191 i	5,869 i	4,547 i	3,225 i	1,903 i	581	--
CA St U Fresno	11,450	10,345	8,785	7,546 i	6,309 i	5,072 i	3,835	3,388 i
CA St U Fullerton	1,749 i	1,749 e	1,749 i	1,749 i	1,749 i	1,749 i	1,749 i	1,749 i
CA St U Hayward								
CA St U Long Beach	31,283	18,563 i	5,843	5,843	5,676 i	5,509 i	5,342 i	5,175 i
CA St U Los Angeles	535	1,033 i	1,531 i	2,029 i	2,527 i	3,025 i	3,523	3,274 i
CA St U Monterey Bay								
CA St U Northridge	3,230	2,175	3,059 i	3,940 i	4,821 i	5,702 i	6,583	--
CA St U Sacramento								
CA St San Bernardino	3,301	390	340 i	294 i	248 i	202 i	156	125 i
CA St U San Marcos								
CA St U Stanislaus								
Humboldt St U	5,557	4,417	4,175 i	3,937 i	3,699 i	3,461 i	3,223 i	2,985 i
San Diego St U	45,579	41,915	40,586	43,201	35,287	29,309	32,493	30,683
San Francisco St U	5,000 e	5,079 i	5,155 i	5,231 i	5,307 i	5,383 i	5,459	4,728 i
San Jose St U	21,005 e	21,005 e	21,005 i	21,005 i	21,005 i	21,005 i	21,005	18,326
Sonoma St U	134	194	--	--	--	--	--	--
Selected Institutions								
Arizona State University	107,184	92,019	80,740	84,653	77,009	62,563	66,142	69,346
Cleveland State U	11,893 e	11,211 e	10,884 e	10,690 i	10,496	10,570	9,803	10,939
George Mason University	26,766	22,543	19,126	23,230	22,221	18,871	15,830	11,930
Georgia State University	36,523	31,153	27,069	18,114	17,867	17,100	12,133	10,026
Illinois State University	4,326	4,688 e	4,596	4,608	5,166	5,071	4,535	3,294
North Carolina Central U	825 e	869	869 e	852 i	835	409	335	755
Rutgers the State U NJ	213,838	197,053	183,038	185,103	192,263	173,211	161,025	162,089
SUNY at Albany	64,278	50,568	57,415	66,247	38,771	43,353	37,860	35,856

University of Colorado	318,618	311,203	269,816	251,301	243,932	234,267	193,217	176,266
University of Connecticut	134,986	134,448	140,840	147,522	139,956	136,740	133,054	124,010
U of MD Baltimore	140,903	143,321	134,808	122,207	107,874	110,866	111,772	100,312
U of Nevada Reno	47,939	45,476	52,703	47,977	46,783	42,176	38,564	37,546
U TX at Arlington	11,450	19,075	37,509	24,010	21,135	17,453	14,834	13,896
U WI-Milwaukee	22,207	20,807	19,995	19,679	19,684	19,180	18,245	18,567
Wayne State University	146,832	138,456	124,383	112,151	106,140	94,632	85,627	81,127
University of California								
U CA Berkeley [2]	451,539	420,426	377,376	316,320	291,200	289,632	284,346	284,545
U CA Davis	307,950	288,796	267,341	254,604	244,116	230,147	223,758	209,282
U CA Irvine	141,842	130,415	119,669	119,647	109,908	104,778	100,631	89,275
U CA Los Angeles	477,620	447,367	398,865	354,645	303,668	279,869	277,974	270,954
U CA Riverside	75,821	79,775	75,486	71,495	62,539	60,995	59,065	57,536
U CA San Diego	461,632	418,790	376,655	371,509	357,333	331,901	307,051	282,114
U CA San Francisco	417,095	379,970	343,384	320,757	329,742	312,393	314,599	295,784
U CA Santa Barbara	104,561	96,034	91,149	91,284	78,737	73,619	68,775	66,007
U CA Santa Cruz	52,902	56,533	49,428	51,062	44,294	42,457	37,886	36,413
Selected Institutions								
California Inst of Tech [2]	212,216	185,066	177,888	157,005	138,016	127,946	115,439	111,733
Harvard University	326,193	306,100	299,961	282,443	276,422	278,459 e	257,207	253,126
Stanford University	426,549	410,309	395,310	351,526	318,871	318,561	306,676	367,980
SUNY at Buffalo	166,823	151,650	135,663	137,701	143,768	141,092	128,203	128,428
U of Illinois Urbana-Cham	358,247	329,266	286,470	268,995	246,174	245,407	252,811	251,970
University of Michigan	508,619	496,761	483,485	468,876	443,070	430,778	425,868	393,059
U of Southern California	280,741	268,806	259,246	244,258	222,159	207,275	200,822	194,740
University of Virginia	157,487	139,135	114,085	97,334	136,679	129,504	115,786	110,103
Yale University	274,050	262,680	245,536	234,901	231,819	224,939	226,850	211,569

[2] These data do not include R&D expenditures at university-administered federally funded research and development centers.

KEY: -- = not available
e = estimated
i = imputed

SOURCE: National Science Foundation/Division of Science Resources Studies,
Survey of Research and Development Expenditures
at Universities and Colleges, Fiscal Year 1999

Discussion of the economic importance of research tends to focus on scientific research and its technological applications. Less immediate and dramatic benefits accrue to the State and nation through research in the humanities and social sciences. Such studies focus on the solution of social, economic, environmental and educational problems, many of which were attributable to rapid changes in, brought about by technological developments. Certainly not the least of the benefits of research in the past century has been the application of social and scientific research toward the improvement of the health and well being of the American people.

If university faculties are to keep up with developments in their fields, to contribute to expanding knowledge and to train students as participants in

the research process, they must be provided the means to do so. Although funding for research may appear to be very costly when considered as an independent or isolated expenditure, the State dollars spent for this purpose are a long-term investment, returning inestimable educational and economic benefits to the State.

Conclusion

The Commission stands ready to work with leaders from California government, education, and industry who will be called upon to identify the State's outstanding needs in the areas of graduate education and research and to address the recognized needs.

In a preliminary perspective, the Commission believes that within public institutions and their institutional mission, efforts should be undertaken to keep graduate assistantships and fellowship stipends competitive and programs of graduate fellowships to recruit academically distinguished students should be enlarged. In those graduate programs preparing students for employment in business and industry, universities should attempt to obtain supporting funds directly from the relevant enterprises.

The Commission believes that by having additional information and discussion as anticipated at this Commission meeting it will be well served to plan for how it can best advise and counsel State policy-makers and educational leaders.

As an initial step, the Commission fully expects that the information provided by the independent sector, the University of California, and the California State University will enable it to have an understanding of the issues and future direction. From the discussion, the Commission anticipates that it will be in a position to offer its recommendations associated with legislative and budgetary priorities aimed at addressing the need to increase California's investment in its graduate education programs and research that better accommodate students in the overall process.